

**Kentucky**  
**Agricultural Experiment Station**  
**University of Kentucky**

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**THE EFFECT OF CONFINEMENT BROODING ON  
GROWTH AND EGG PRODUCTION**

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**BULLETIN NO. 346**  
(RESEARCH BULLETIN)

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Lexington, Ky.  
January, 1934

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## **BULLETIN NO. 346**

(RESEARCH BULLETIN)

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### **The Effect of Confinement Brooding on Growth and Egg Production**

By G. DAVIS BUCKNER, J. HOLMES MARTIN and W. M. INSKO, JR.

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Wire-floored battery brooders are being used extensively for raising chickens. This practice which saves labor and controls certain infestations has raised other serious problems for investigation. This bulletin contains the results of a study of the comparative growth of incubator-hatched White Leghorn chickens brooded and raised according to three methods, and shows the influence of these methods on the hatchability and number of eggs laid by the mature pullets.

#### **METHOD OF PROCEDURE**

At the beginning of the experiment, April 7, 1931, 360 one-day-old White Leghorn chicks were divided into three lots and weighed individually. Lot 1, which was to represent normal farm-raised chickens, was raised in a colony brooder house with access to bluegrass range and direct sunlight. Lot 2 was kept during the first three weeks in the battery brooder\* with lot 3 and then transferred to the colony brooder house with lot 1. Lot 3 was kept in the battery brooder during the first 22 weeks. The chicks of lot 3, when ten weeks of age, were transferred to compartments 18 inches high, in the same brooder. The chicks were raised under these three sets of conditions until housed at 22 weeks of age. They were weighed every two weeks thru the growing period.

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\* A five-deck battery brooder, the compartments 3 feet square and 9 to 10 inches high, situated in a basement where it received no direct sunlight.



In all three lots the cockerels were separated from the pullets when they were ten weeks old. All lots received the same ration which consisted of:

|                               | Parts |
|-------------------------------|-------|
| Wheat bran .....              | 25    |
| Wheat middlings .....         | 25    |
| Ground yellow corn .....      | 25    |
| Meat scrap (50% protein)..... | 12    |
| Dried buttermilk .....        | 10    |
| Salt .....                    | 1     |
| Steamed bone meal .....       | 5     |

Enough of a commercial cod liver oil concentrate (.125% of the mash) was added to protect adequately against rickets. This mash and a grain mixture consisting of equal parts of cracked yellow corn and wheat were before the chickens in hoppers at all times.

Table 1 gives the chemical analysis of the mash fed to the three lots thruout the experiment.

**TABLE 1. Composition of the mash**

|                             | Percent |
|-----------------------------|---------|
| Protein .....               | 19.80   |
| Fat .....                   | 6.49    |
| Fiber .....                 | 5.55    |
| Ash .....                   | 12.05   |
| Water .....                 | 8.68    |
| Nitrogen-free extract ..... | 47.43   |
|                             | <hr/>   |
|                             | 100.00  |
| Phosphorus .....            | 2.00    |
| Calcium .....               | 3.36    |

$$\text{Ca:P} = 1.68:1$$

After four weeks, two pullets and two cockerels, of average weight were taken from lot 1, and one cockerel and one pullet from lot 2 and 3, each, for analysis. At the end of each four-week period thereafter, two pullets and two cockerels were removed from each lot. The average weights of the pullets and

cockerels that survived for 24 weeks were calculated for each of the weight periods.

**TABLE 2. Bi-weekly average weights of chickens alive on the final weigh day (grams).**

| Date     | Wks. | Lot 1. Colony<br>brooder raised |               | Lot 2. Battery<br>brooder started |               | Lot 3. Battery<br>brooder raised |               |
|----------|------|---------------------------------|---------------|-----------------------------------|---------------|----------------------------------|---------------|
|          |      | 43<br>Cock-<br>erels            | 48<br>Pullets | 50<br>Cock-<br>erels              | 40<br>Pullets | 41<br>Cock-<br>erels             | 41<br>Pullets |
| April 7  | 0    | 38                              | 39            | 39                                | 39            | 40                               | 39            |
| April 21 | 2    | 75                              | 72            | 85                                | 80            | 85                               | 81            |
| May 5    | 4    | 180                             | 168           | 219                               | 196           | 216                              | 195           |
| May 19   | 6    | 328                             | 287           | 355                               | 311           | 356                              | 309           |
| June 2   | 8    | 464                             | 409           | 485                               | 427           | 464                              | 379           |
| June 16  | 10   | 719                             | 603           | 741                               | 631           | 794                              | 663           |
| June 30  | 12   | 854                             | 686           | 846                               | 710           | 1005                             | 785           |
| July 14  | 14   | 1049                            | 874           | 1064                              | 884           | 1227                             | 958           |
| July 28  | 16   | 1115                            | 846           | 1095                              | 857           | 1334                             | 1067          |
| Aug. 13  | 18   | 1391                            | 1004          | 1327                              | 1027          | 1437                             | 1176          |
| Aug. 25  | 20   | 1575                            | 1158          | 1489                              | 1183          | 1539                             | 1253          |
| Sept. 8  | 22   | 1691                            | 1305          | 1629                              | 1317          | 1636                             | 1336          |
| Sept. 22 | 24   | 1736                            | 1359          | 1673                              | 1385          | 1639                             | 1341          |

#### RATE OF GROWTH AND MORTALITY

Table 2 gives the average bi-weekly weights of the cockerels and pullets (see Figs. 1 and 2) that survived for 24 weeks. It will be seen that at the end of twenty-four weeks the average weight of the forty-three cockerels remaining in lot 1 was 63 grams more than the average weight of the 50 surviving cockerels in lot 2 and 97 grams more than that of the forty-one cockerels remaining in lot 3 (battery brooder raised). The mortality of the cockerels was lower in lots 1 and 2 than in lot 3, the cause not being apparent unless it was the confinement of lot 3. The average weight of the pullets remaining in lot 1 was 26 grams less than the average weight of those remaining in lot 2 and 18 grams more than that of those surviving in lot 3.

At the end of the fifteenth week all the birds were vaccinated for fowl pox, which probably accounts for the retarded growth

of the cockerels in lots 1 and 2. The pullets in lots 1 and 2 became mildly infested with roundworms (*Ascaris*) and nicotine sulfate capsules were administered individually in the fifteenth

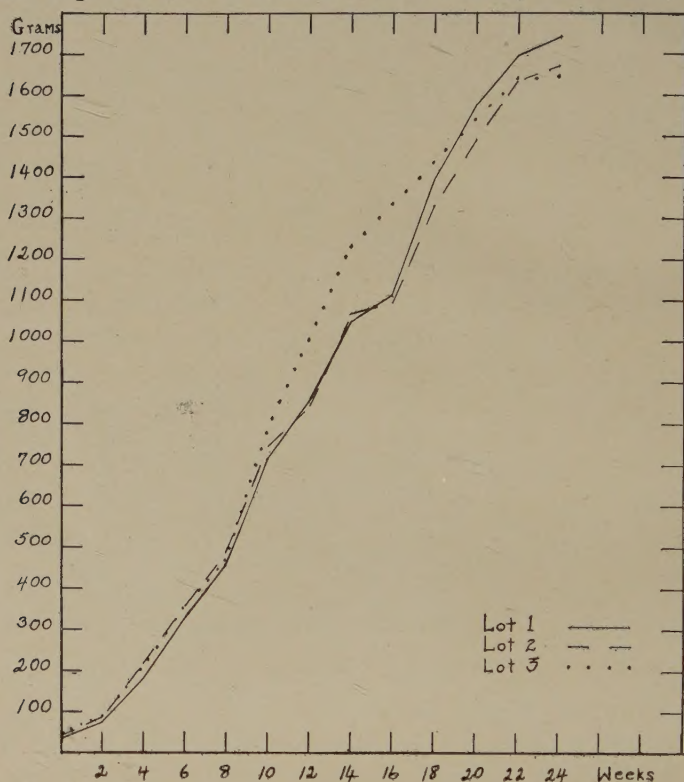


Figure 1. Growth curves of the cockerels that survived for 24 weeks.

week. Retarded growth in these pullets was followed by an acceleration of growth after treatment. Within two weeks the pullets had recovered and by the twenty-second week the average weights of the pullets in these two lots approximated that of the pullets in lot 3, which had outgrown lots 1 and 2 from the tenth thru the twenty-second week. The cockerels in lot 3 outgrew the other two lots from the tenth thru the eighteenth week.

The cockerels and pullets in lots 1 and 2 were apparently the same in health and vigor and their combs and wattles were



normal and similar in development at 22 weeks of age (see Figs. 3, 4 and 6). While the cockerels and pullets in lot 3 did not differ

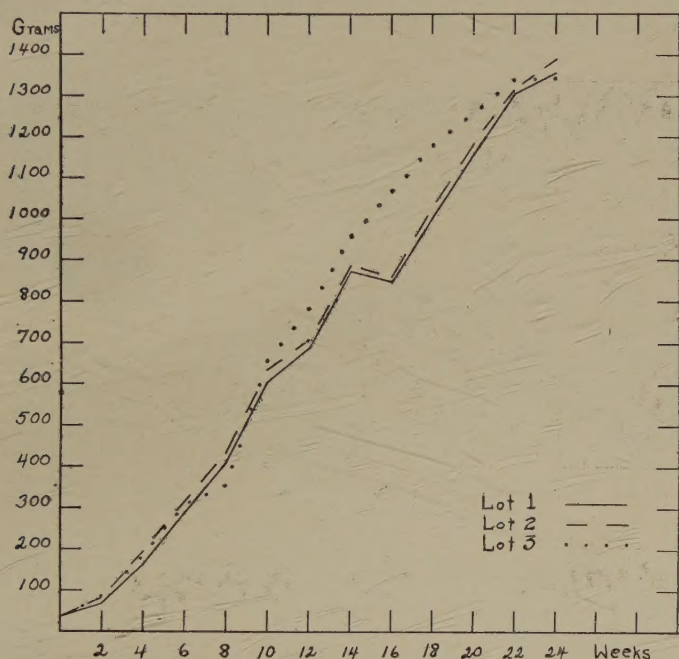


Figure 2. Growth curves of the pullets that survived for 24 weeks.

widely in average weight from those in lots 1 and 2, their general condition was not so good, since they appeared droopy and less active (see Fig. 5). The combs of the cockerels as well as of the pullets in lot 3 were lopped and were larger than those of corresponding sexes in the other two lots whose combs were erect, as is illustrated in Figure 6.

At the end of the twenty-fourth week, six cockerels from each lot were selected for further study. Altho the cockerels selected from lot 3 were smaller than those from lots 1 and 2, the average weight and average size of their combs were more than twice those of the combs of the range-raised birds. The average weight of the testes of 6 cockerels from lot 1 (raised in the colony brooder) was 5 grams at 24 weeks of age, double that

of the cockerels from lot 3, raised in the battery brooder (see Fig. 7). The testes of the cockerels from lot 3, besides being smaller (average of 6 cockerels, 2.5 grams), were found to be

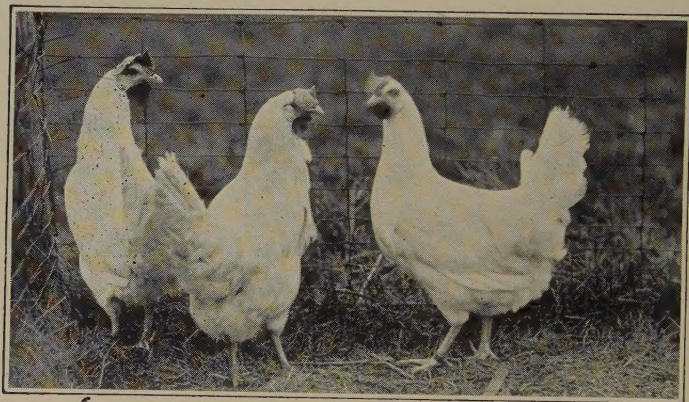


Figure 3. Representative pullets in lot 1.

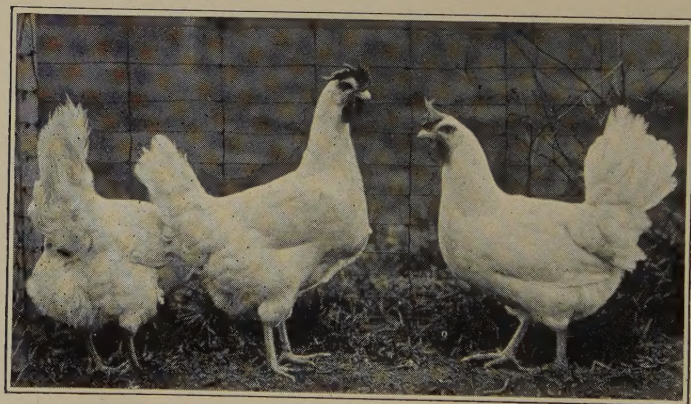


Figure 4. Representative pullets in lot 2.

less moist when cut than those from the other two groups. While the comparative number of spermatozoa in the semen from the three sets of cockerels was not determined, it was observed that there were decidedly fewer in the semen obtained from the seminal vesicles of the cockerels in lot 3.



The fertilizing power of the cockerels in lot 3 was found to be low as compared with the cockerels in lots 1 and 2, when mated with hens which had previously produced hatchable eggs. This may have been due to the smaller testicles or to a smaller number of spermatozoa, as well as to the enlarged combs and partial blindness which unbalanced the cockerels and interfered with copulation. Even the most vigorous cockerels from lot 3



Figure 5. Representative pullets in lot 3.

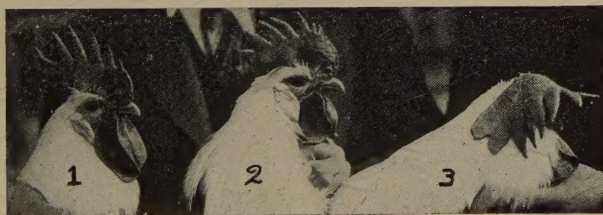


Figure 6. Representative cockerels in lots 1, 2 and 3.

mated only occasionally, and then with much awkwardness. For this reason normal cockerels were mated to lot 3 as well as to lots 1 and 2, to test the hatchability of the eggs from the three groups of pullets (see p. 14).

It seems possible that the enlarged combs were associated with the exclusion of direct sunlight, the cockerels elaborating combs with larger surfaces to compensate for the decreased

quantity of solar radiation received. The development of smaller testes which in two instances were rudimentary may have been due also to the decreased quantity of solar radiation received. It is a well-known fact that close confinement is not

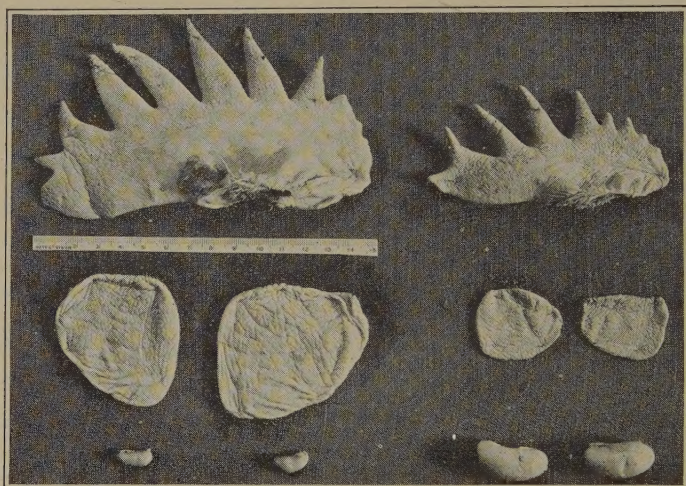


Figure 7. Relative size of the combs, wattles and testes of cockerels raised in the battery brooder (left) and in the colony brooder.

beneficial for breeding males and that the lack of exercise usually leaves the male somewhat heavier than normal and in poorer breeding condition. These results are discussed by the authors more in detail elsewhere.<sup>1</sup>

These data show that the rates of growth of the cockerels and pullets raised under the three sets of conditions were not very different, and they closely approximate the rates of growth of cockerels and pullets obtained by Mitchell, Card and Hamilton.<sup>2</sup>

To determine to what extent natural mortality and the removal of cockerels and pullets of average weight influenced the value obtained for the average rate of growth, calculations were made of the average weights of all pullets and cockerels alive on

<sup>1</sup> Buckner, G. Davis, J. Holmes Martin and W. M. Insko, Jr., 1932. *Amer. Jour. Physiol.*, Vol. 102, No. 2, 271-275.

<sup>2</sup> Mitchell, H. H., L. E. Card, and T. S. Hamilton, 1931. *Ill. Agr. Exp. Sta. Bul.* 369.



each weigh-day during the experiment, the average weights of all pullets and cockerels alive on each weigh-day, excluding the preceding weights of those that died up to that date or were removed for analysis, and the average weights of the pullets and cockerels that survived the experiment. The differences between the mean weight for the cockerels or pullets computed by these three methods were slight and not significant. These data have been published elsewhere.<sup>3</sup>

Among the cockerels there were no cases of slipped tendon in lot 1, three in lot 2 and four in lot 3. None of the pullets developed slipped tendon. Two cockerels and two pullets having approximately the average weight for each sex in the three lots at each four-week period were killed and the six large leg bones, femur, tibia and metatarsus, were dissected out, ashed and the percentages of ash and of calcium oxide and phosphorus pentoxide in the ash determined. Tables 3, 4 and 5 show that the percentages of CaO and  $P_2O_5$  in the ash of the leg bones of the cockerels and pullets in the three lots remained relatively constant during the experiment. However, the percentages of ash in the dry leg bones were lowest in the cockerels and highest in the pullets that were raised in the battery brooder during the period of growth.

TABLE 3. Percentage of Ash in the dry leg bones.

| Age<br>Weeks | Cockerels |       |       | Pullets |       |       | Av.  |
|--------------|-----------|-------|-------|---------|-------|-------|------|
|              | Lot 1     | Lot 2 | Lot 3 | Lot 1   | Lot 2 | Lot 3 |      |
| 4            | 36.9      | 36.8  | 36.4  | 38.3    | 37.1  | 40.0  | 37.6 |
| 8            | 36.4      | 38.3  | 39.2  | 39.5    | 34.9  | 36.7  | 37.5 |
| 12           | 43.6      | 44.2  | 37.4  | 39.3    | 39.8  | 38.5  | 40.5 |
| 16           | 38.4      | 41.3  | 36.6  | 36.7    | 39.1  | 45.5  | 39.6 |
| 20           | 39.8      | 42.3  | 35.6  | 45.5    | 40.7  | 43.0  | 39.6 |
| 24           | 40.0      | 42.7  | 35.5  | 43.5    | 40.0  | 44.4  | 41.0 |
| Average      | 39.2      | 40.9  | 36.8  | 40.5    | 38.6  | 41.3  | 39.6 |

<sup>3</sup> Buckner, G. Davis, W. M. Insko, Jr., and J. Holmes Martin, 1934. Poul. Sci., Vol. 13, No. 2:110-115.

**TABLE 4. Percentage of  $P_2O_5$  in the ash of the leg bones.**

| Age<br>Weeks | Cockerels |       |       | Pullets |       |       | Av.  |
|--------------|-----------|-------|-------|---------|-------|-------|------|
|              | Lot 1     | Lot 2 | Lot 3 | Lot 1   | Lot 2 | Lot 3 |      |
| 4            | 40.0      | 40.0  | 40.5  | 40.4    | 40.4  | 39.6  | 40.2 |
| 8            | 39.8      | 40.2  | 40.8  | 40.5    | 40.7  | 39.4  | 40.3 |
| 12           | 40.6      | 40.6  | 41.1  | 40.1    | 40.2  | 41.4  | 40.7 |
| 16           | 39.7      | 40.7  | 40.7  | 39.9    | 40.4  | 40.9  | 40.4 |
| 20           | 41.4      | 40.2  | 41.3  | 40.7    | 40.3  | 41.5  | 40.9 |
| 24           | 39.4      | 38.5  | 39.8  | 39.8    | 39.2  | 39.7  | 39.4 |
| Average      | 40.2      | 40.0  | 40.7  | 40.2    | 40.2  | 40.4  | 40.3 |

**TABLE 5. Percentage of CaO in the ash of the leg bones.**

| Age<br>Weeks | Cockerels |       |       | Pullets |       |       | Av.  |
|--------------|-----------|-------|-------|---------|-------|-------|------|
|              | Lot 1     | Lot 2 | Lot 3 | Lot 1   | Lot 2 | Lot 3 |      |
| 4            | 50.5      | 50.5  | 49.3  | 50.7    | 50.7  | 50.0  | 50.3 |
| 8            | 49.7      | 51.5  | 49.3  | 50.4    | 49.8  | 49.2  | 50.0 |
| 12           | 51.4      | 50.5  | 50.7  | 49.8    | 51.2  | 50.3  | 50.7 |
| 16           | 50.6      | 50.6  | 50.3  | 50.4    | 50.2  | 50.3  | 50.4 |
| 20           | 50.2      | 50.3  | 50.6  | 50.8    | 50.2  | 51.2  | 50.4 |
| 24           | 51.2      | 50.0  | 51.5  | 49.8    | 51.2  | 50.4  | 50.7 |
| Average      | 50.6      | 50.6  | 50.3  | 50.3    | 50.9  | 50.2  | 50.5 |

**EGG PRODUCTION**

On September 8, 1931 (at 22 weeks of age), 48, 40 and 41 pullets remained in lots 1, 2 and 3, respectively. During the following year a trap-nest record was kept of the egg production of each lot. At the end of the pullet year, September 7, 1932, 39, 33 and 17 pullets remained in lots 1, 2 and 3, respectively, a mortality of 18.8 percent in lot 1, 17.5 percent in lot 2 and 58.5 percent in lot 3. The average egg production of the pullets surviving the experiment was highest (202 eggs per hen) in lot 2 and lowest (154.6 eggs) in lot 3. The battery brooder



**TABLE 6.** Monthly average egg production during the first laying year of the pullets surviving the experiment.

|                    | Lot 1<br>Colony brooder<br>raised | Lot 2<br>Battery brooder<br>started | Lot 3<br>Battery brooder<br>raised |
|--------------------|-----------------------------------|-------------------------------------|------------------------------------|
| Oct., 1931 .....   | 10.5                              | 19.2                                | 8.0                                |
| Nov. ....          | 10.1                              | 18.2                                | 8.6                                |
| Dec. ....          | 11.4                              | 13.7                                | 9.2                                |
| Jan., 1932 .....   | 13.7                              | 14.2                                | 9.2                                |
| Feb. ....          | 16.1                              | 17.6                                | 9.3                                |
| Mar. ....          | 18.6                              | 21.2                                | 14.2                               |
| Apr. ....          | 20.0                              | 22.0                                | 19.9                               |
| May ....           | 21.8                              | 19.5                                | 20.7                               |
| June ....          | 19.2                              | 17.3                                | 19.3                               |
| July ....          | 17.1                              | 14.0                                | 13.9                               |
| Aug. ....          | 16.1                              | 13.1                                | 15.6                               |
| Sept. ....         | 10.4                              | 12.0                                | 6.7                                |
| Av. for 12 months  | 185.0                             | 202.0                               | 154.6                              |
| Av. Nov. thru Feb. | 51.3                              | 63.7                                | 36.3                               |

raised pullets were the poorest layers of the three lots. Just why the battery started pullets exceeded the colony raised pullets 17 eggs per hen is not apparent unless, perhaps, it was because they lived for the first six weeks on the wire floor of the brooder where no intestinal parasites were present.

**TABLE 7.** Number and average weight of eggs laid by the pullets in each lot during January, February and March.

| Lot | Treatment                  | No. of<br>Eggs | Average weight |       |       | Ave.<br>weight<br>for<br>three<br>months |
|-----|----------------------------|----------------|----------------|-------|-------|------------------------------------------|
|     |                            |                | Jan.           | Feb.  | Mar   |                                          |
|     |                            |                | grams          | grams | grams | grams                                    |
| 1   | Colony brooder raised .... | 482            | 53.2           | 53.4  | 53.6  | 53.5                                     |
| 2   | Battery brooder started... | 475            | 52.9           | 54.5  | 54.8  | 54.3                                     |
| 3   | Battery brooder raised.... | 189            | 50.0           | 51.0  | 51.7  | 51.2                                     |

In Table 7 will be found the average weights of the eggs from the three lots during January, February and March; 53.5,

54.3 and 51.2 grams, respectively. The difference between lots 1 and 2 was not significant but the average weight of the eggs laid by the battery brooder raised pullets was significantly less than that of the other two lots.

In Table 8 will be found the hatchability record of the eggs laid during January, February and March. Three cockerels which had been tested for fertility were placed in each pen and sufficient time allowed for establishing fertility before eggs were saved for hatching (see p. 9). It will be seen that there were only small differences (not significant) in fertility and hatchability between the three lots. The mortality of the pullets during the first laying year was considerably greater among those raised in the battery brooder than in the other lots. Pullets raised in the colony brooder, with access to sunlight and bluegrass range, and those raised in the battery brooder for six weeks before being placed in the colony brooder, laid more eggs

**TABLE 8. Hatchability of eggs.**

|                                       | Jan. | Feb. | Mar. | Summary |
|---------------------------------------|------|------|------|---------|
| <b>Lot 1. Colony brooder raised</b>   |      |      |      |         |
| Total eggs set .....                  | 110  | 136  | 238  | 484     |
| Fertile eggs, percent .....           | 98.2 | 98.3 | 90.4 | 93.9    |
| Chicks hatched .....                  | 101  | 118  | 170  | 389     |
| Fertile eggs hatched, percent.....    | 93.5 | 90.1 | 82.5 | 87.4    |
| Total eggs hatched, percent.....      | 91.8 | 86.8 | 74.6 | 82.1    |
| <b>Lot 2. Battery brooder started</b> |      |      |      |         |
| Total eggs set .....                  | 107  | 119  | 243  | 469     |
| Fertile eggs, percent .....           | 95.3 | 95.0 | 88.1 | 91.5    |
| Chicks hatched .....                  | 98   | 99   | 183  | 380     |
| Fertile eggs hatched, percent.....    | 96.1 | 87.6 | 85.5 | 88.6    |
| Total eggs hatched, percent.....      | 91.6 | 83.2 | 75.3 | 81.0    |
| <b>Lot 3. Battery brooder raised</b>  |      |      |      |         |
| Total eggs set* .....                 | 40   | 41   | 100  | 181     |
| Fertile eggs, percent .....           | 97.5 | 92.7 | 88.0 | 91.2    |
| Chicks hatched .....                  | 35   | 31   | 80   | 146     |
| Fertile eggs hatched, percent.....    | 89.7 | 81.6 | 90.9 | 88.5    |
| Total eggs hatched, percent .....     | 87.5 | 75.6 | 80.0 | 80.6    |

\* The number of eggs set from lot 3 is small because only 29 hens remained at the start of the hatching season and they were not laying as well as the other hens.



and larger eggs in the winter period (November thru February) and the pullet year, than those raised for twenty-two weeks in the battery brooder without direct sunlight. However, the fertility and hatchability of the eggs produced by the three lots of pullets were practically the same.

#### SUMMARY AND CONCLUSIONS

There were no great differences in the rates of growth of the chickens raised under the three sets of conditions in this experiment. The rates of growth of the cockerels and pullets closely approximated the rates of growth obtained by Mitchell, Card and Hamilton.<sup>2</sup> The average weight of the cockerels was greater and the average weight of the pullets was less at the age of twenty-four weeks than the weights obtained for corresponding sexes and ages of the same breed at the Kentucky Agricultural Experiment Station in 1916.<sup>4</sup>

The pullets and cockerels in lots 1 and 2, which were colony brooder raised and battery brooder started, respectively, were more vigorous, active and healthier in appearance than those of the corresponding sexes in lot 3, raised indoors and without direct sunshine during the period of twenty-two weeks.

The results of these experiments show that cockerels raised in confinement in a battery brooder from which direct sunlight was excluded, developed abnormally large combs and smaller testes than those raised in a colony brooder, with access to a grass range and receiving direct sunlight.

During the first laying year the mortality was considerably greater among pullets raised in the battery brooder than in the other two lots. Pullets raised in the colony brooder, with access to sunshine and a grass range, and those raised in the battery brooder for six weeks before being placed in the colony brooder, laid more eggs and larger eggs in the winter period (November thru February) and the pullet year, than those raised for

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<sup>4</sup>Buckner, G. D., R. H. Wilkins, and J. H. Kastle, 1918. *Am. Jour. Physiol.*, Vol. 47, No. 3: 393-398.



twenty-two weeks in the battery brooder without direct sunlight. However, there was no difference in the fertility and hatchability of the eggs produced by the three lots of pullets raised under the conditions described.